CEVE / ESCI / ENST 307
ENERGY AND THE ENVIRONMENT
SPRING 2012

Meeting Times and Location:
T/Th 9:25 – 10:40 a.m., Mech Lab 251

Instructor:
Daniel Cohan, Ph.D.
Assistant Professor of Civil & Environmental Engineering
Office: Keck Hall 116B
Phone: 713-348-5129
Email: cohan@rice.edu

Office Hours:
Tuesdays 2-4 p.m. Visits at other times are also welcomed, via email request.

Course Description:
Securing sufficient, reliable, and affordable supplies of energy in an environmentally sustainable manner is among the greatest challenges facing society in the 21st century. Appreciating and addressing this complex challenge requires consideration of the various physical, technological, and societal forces that shape energy use and its impact on the environment.

This course will explore the physical principles of energy and how various sectors and fuels impact Earth's environment and climate. We will also examine policies and technologies that could foster more sustainable use of energy resources. The course will include a group project in which students will design and advocate potential policy, research, or business approaches to a particular energy source.

Course Objectives:
This course aims not only to impart heightened knowledge of energy and its impacts on the environment, but also to build skills in research, analysis, and critical thinking that will catalyze a lifetime of engagement with this complex topic. Among the learning objectives for this course, students completing this course will be able to:

1) Characterize the performance of engines, heat pumps, and power plants
2) Identify key environmental impacts of various energy sources
3) Compute the energy return on investment, overall efficiency, and resource intensity for an energy source
4) Obtain objective, credible data and projections for energy availability, consumption, and impacts, and critically evaluate conflicting estimates
5) Compare and contrast the challenges posed by regional air pollution and global climate change and their relation to energy use
6) Critically assess conflicting evidence regarding energy technologies or policies
7) Design and present a persuasive case advocating a policy, scientific study, or business initiative related to an energy source

Prerequisites:

While there are no explicit prerequisites, this course will apply quantitative approaches and scientific principles to examine energy and the environment. Physics and calculus background at least to the level of PHYS 101 and MATH 101 (or AP equivalents) are strongly recommended. Please contact the instructor if you have questions regarding your preparation.

Textbook and Readings:

James Fay and Dan Golomb. *Energy and the Environment, Second Edition*. Oxford University Press, 2012.

Additional readings from outside sources will be assigned and made available on the OwlSpace website for the course.

Honor System Policy:

All students are expected to adhere to the Rice Honor Code. Exams will be given under the honor system and must be entirely a student's own work, using only resources that are explicitly authorized for that exam. Homework assignments may be discussed with other students but must be written individually in your own words. Essays and group papers must properly cite all references used and must be written entirely in the student's own words except where explicitly denoted by direct quotations.

Disability Statement:

If you have a documented disability that will impact your work in this class, please contact me to discuss your needs. Additionally, you will need to contact the Disability Support Services Office in the Allen Center.

Grading:

Students will be evaluated by their performance on the following:

Written assignments	25%
Midterm Exam	20%
Group project (Oral presentation and written report)	20%
Final Exam	35%

Overall grades may be adjusted by up to +/- 3 points based on attendance and participation, which are crucial to the success of this course.

All assignments are due by the end of class on the due date. Late assignments will incur a penalty of 25 points and will not be accepted after solutions are distributed. Extensions will be granted only by email request describing specific extenuating circumstances.

TENTATIVE SCHEDULE (*subject to change*)

DATE	THEME	TOPIC	TEXTBOOK	OUTSIDE READINGS*
1/10	**Introduction**	The Energy Challenge	Ch. 1; Ch. 2.1-2.6	
1/12	**Energy: Physical Principles**	Energy, work, and power; First Law of Thermodynamics	Ch. 3.1-3.4	
1/17		Second Law; Heat transfer and heat engines	Ch. 3.5-3.9	Wolfson Chap. 4
1/19		Refrigerators and heat pumps; energy processing	Ch. 3.10-3.13	
1/24	**Energy: Sectors**	Electricity and the Electric Sector	Ch. 5.1-5.3; Ch. 6	smart grid (Levinson)
1/26		Transportation Sector	Ch. 9.1-9.6	CAFE standards (Taking Sides); Plug-in hybrids (EIA)
1/31	**The Environment**	Water & land	Ch. 10.3-10.4	Energy/water (DOE); water/transportation (King); land/ electricity (Fthenakis)
2/2		Air	Ch. 10.1-10.2	Ozone and particulate matter (US EPA)
2/7		Climate	Ch. 11	Climate change (IPCC)
2/9		Climate (cont.)		Policy options (Pacala)
2/14		Emissions control; carbon capture & storage	Ch. 6.2.10; Ch. 9.7; Ch. 12	Carbon capture (IPCC; Rubin)
2/16	**Comparing Energy Options**	Cost and energy metrics		Electricity costs (Kammen); EROI (Encyc. of Earth); well-to-wheels (Wang)
2/21		Environmental metrics		Life cycle assessment (Rebitzer; Samaras); externalities (Stirling)
2/23	**Policy Responses**	Regulatory and market-based approaches		

2/27 – 3/2		SPRING BREAK		
3/6		Sustainability at Rice (Richard Johnson and Doug Wells)		
3/8	**MIDTERM EXAM (in-class)**			
3/13	**Fossil Fuels**	Oil	Ch. 2.7.2-2.7.3; Ch. 4.2-4.3	Peak oil (GAO); oil supply (Kjarstad)
3/15		Natural Gas	Ch. 2.7.4-2.7.5	Overview (EIA); impacts (Afgan)
3/20		Coal	Ch. 2.7.1; 4.5.1	Overview (EIA); Future of coal (MIT)
3/22 – 3/23		SPRING RECESS		
3/27	**Alternative Fuels**	Energy conservation & efficiency		Efficiency policies (Geller)
3/29		Nuclear	Ch. 7	Future of nuclear (MIT; Scientific American); Open cycle (Taebi)
4/3		Solar	Ch. 8.5	Comparing alternatives (Jacobson); market report (NREL)
4/5		Biomass energy	Ch. 4.4, 4.6; Ch. 8.3	Biofuels (Hill); algae (Chisti); biochar (Lehmann); cellulosic (Wyman)
4/10		Wind	Ch. 8.6	20% wind scenario (DOE)
4/12		Hydroelectricity, Oceans, & Geothermal	Ch. 8.2, 8.4, 8.7-8.9	Ocean energy (NREL); geothermal (NREL); hydropower (IEA)
4/17		Hydrogen as an energy carrier; futuristic options	Ch. 4.7-4.8; Ch. 9.6.3	Hydrogen; futuristic options (Scientific American)
4/19	**Summary**	Summing up the Energy Challenge		
		FINAL EXAM (*take-home*)		

*Outside reading assignments will be made available via the course OwlSpace website. The list of outside readings is tentative and may change as the semester progresses.